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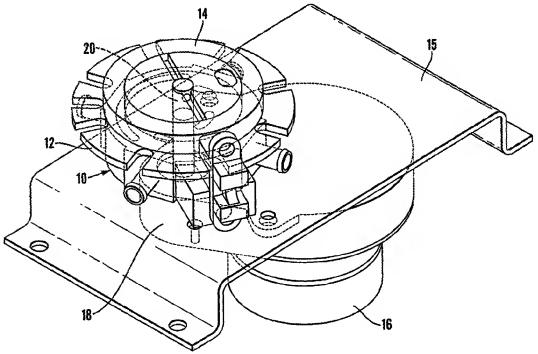


(57) Abrégé/Abstract:
A rotary valve is described for use in controlling an air supply to an inflatable patient support system, especially an alternating pressure mattress. The valve comprises a rotary valve for controlling air supply to an alternating pressure patient support system which comprises a body member (10) having a planar surface (21) and at least two apertures (25, 26) for communication with cells or sets of cells in the patient support system, and a further aperture (22) for connection to a pressurised air source, an actuator member (12) which is rotatable in face to face contact with said planar surface, said actuator having a recessed portion (38) which forms an air supply chamber when in contact with said planar surface is positioned to be constantly supplied with air from said further aperture, drive means (16, 18) for rotating the actuator with respect to the first member and detector means (32) for detecting the position of the actuator relative to the body member and, in conjunction with control means, for controlling the timing and duration of air supply to the cells or sets of cells.

ABSTRACT

A rotary valve is described for use in controlling an air supply to an inflatable patient support system, especially an alternating pressure mattress. The valve comprises a rotary valve for controlling air supply to an alternating pressure patient support system which comprises a body member (10) having a planar surface (21) and at least two apertures (25, 26) for communication with cells or sets of cells in the patient support system, and a further aperture (22) for connection to a pressurised air source, an actuator member (12) which is rotatable in face to face contact with said planar surface, said actuator having a recessed portion (38) which forms an air supply chamber when in contact with said planar surface is positioned to be constantly supplied with air from said further aperture, drive means (16, 18) for rotating the actuator with respect to the first member and detector means (32) for detecting the position of the actuator relative to the body member and, in conjunction with control means, for controlling the timing and duration of air supply to the cells or sets of cells.

ROTARY VALVE

This invention relates to rotary valves and, in particular, to rotary valves for use in controlling an air supply to alternating pressure patient support systems.

Alternating pressure mattresses are commonly used for prevention and treatment of pressure sores and alternating pressure pads have been used in other patient support equipment, such as wheelchair cushions. Alternating pressure systems are linked to a pump or other source of air pressure via a control system which alternately inflates and deflates different cells or sets of cells within the patient support structure. The variation in interface pressure between the patient's skin and the mattress reduces the incidence of pressure sores.

Two methods have been used to distribute air to and from the mattress cells in order to produce the alternating pressure effect. These are rotary valves and multiple solenoid valves. Rotary valves which have been used in the past have included an actuator plate continuously rotating against a valve face. The actuator plate is formed with slots and holes which periodically align with holes in the valve face, thus opening and closing air ports. The cycle time is governed by the speed at which the actuator rotates across the valve face and the timing of each opening and closing event is determined by the positions and dimensions of slots and holes in the valve assembly and the speed of rotation.

Although rotary valves of this type are relatively inexpensive, simple and reliable, they have the disadvantage that continuous operation of the motor increases

power consumption and the timing of the opening and closing events within one cycle is fixed.

The second method of controlling alternating pressure mattresses and other support systems are solenoid valves. Although solenoid valves can be readily controlled by a micro-processor, they have the disadvantages that they are relatively expensive and give limited flow rate so that large capacity valves are required. They are also relatively noisy, tend to be unreliable in use and have a high power consumption.

The present invention provides an improved rotary valve system which combines most of the advantages of conventional rotary and solenoid valves.

According to one aspect of the present invention, there is provided a rotary valve for controlling air supply to an alternating pressure patient support system which comprises a body member having a planar surface and at least two apertures for communication with cells and/or sets of cells in the patient support system, and a further aperture for connection to a pressurised air source, an actuator member which is rotatable in face to face contact with said planar surface, said actuator having a recessed portion which forms an air supply chamber when in contact with said planar surface and is positioned to be constantly supplied with air from said further aperture, drive means for rotating the actuator with respect to the first member and detector means for detecting the position of the actuator relative to the body member, and in conjunction with control means, for controlling the timing and duration of air supply to the cells or sets of cells.

Preferably, the actuator also includes an aperture through which air can be exhausted in turn from one or other of the cells or sets of cells.

The detector preferably comprises at least one optical sensor mounted in the vicinity of the actuator and arranged to detect the position of the actuator relative to the body member. In one embodiment, the sensor interacts with apertures or slots in the actuator which are conveniently located around the perimeter.

Preferably, the drive means is capable of rotating the actuator in both directions and this gives greater flexibility to the sequence of events, timing and duration of air supply to the cells.

One embodiment of a rotary valve in accordance with the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of the assembled valve;

Figure 2 is a perspective view of the actuator plate; and

Figure 3 is a perspective view of the valve body member.

Referring to the drawings, the rotary valve comprises a body member 10 and a rotary actuator 12. The valve is mounted as shown in Figure 1 on a plate 15, beneath which is located a two directional drive comprising a motor 16 and a gearbox 18. The gearbox 18 incorporates a drive spindle 20 which extends through the valve body member 10 and is engageable with the actuator plate 12, to rotate the plate relative to the valve body. A spring is provided (not shown) to press the valve body and actuator together.

The valve member is shown best in Figure 3 and it will be seen that the member comprises a planar face 21, having a central opening 23 for the drive shaft for

the actuator plate and an aperture 22 for admission of pressurised air from a pump. The pump is not shown in the drawings, but would be connected to an air inlet 24 in one side of the body member. The planar surface 21 incorporates two diametrically opposed apertures 25 and 26, which are connected respectively to outlet ports 28 and 29 for connection to the first and second set of cells. The planar surface 21 also includes an arcuate slot 30 which can be arranged to supply other functions of the bed but, in this case, is not used.

Also shown in Figure 3 is an optical switch and receptor 32 which is connected to a connector pin 34, for linkage to a micro-processor.

Figure 2 shows the actuator plate looking at the face 36 which is intended to be placed in face to face contact with the planar surface 21. Actuator plate 12 may be machined, e.g. from metal or plastic, or manufactured as a moulding. The actuator plate incorporates a recess 38 which forms a supply chamber for air to the valve. The plate also includes the port 40 for exhausting air from the two sets of cells.

Around the perimeter of the actuator plate is provided a series of indexing slots 42. As can be seen from the drawing, there are nine slots arranged at varying intervals around the perimeter.

In operation, the actuator face 36 is in contact with the valve face 21, and is driven by the motor and gearbox 16,18 in one or other direction under the control of the micro-processor (not shown). The drive to the plate is arranged through the hub 44.

In use, the aperture 22 is always in communication with the supply chamber 38. By virtue of the shape of the chamber and the position of the actuator plate on the

valve face, air is supplied to one or other or both of the sets of valves. The apertures or slots 42 in the perimeter of the actuator face interact with the optical switch 32, in order that the control means can detect the position and hence the operating position of the actuator plate in the valve.

The slots 42 around the perimeter of the actuator plate each correspond with an index point which represents a particular status with regard to the two groups of cells. The various index point positions are shown below.

Index Point	Cell A	Cell B
1	Fill	Fill
2	Fill	Hold inflated
3	Fill	Exhaust
4	Fill	Hold deflated
5	Fill	Fill
6	Hold inflated	Fill
7	Exhaust	Fill
8	Hold deflated	Fill

It will be seen that eight positions are listed above but that there are now slots in the actuator perimeter. This extra slot is needed for the operating software to find the home position at the start up of the apparatus. Thus, when initially switching on the equipment, the valve has lost orientation and the control device therefore rotates the actuator until the optical switch sees three slots in close proximity. At the third

slot, it is able to recognise this position as index point 1 and, in further operation of the equipment, this extra slot is no longer used.

The valve described above can be used in conjunction with any type of alternating pressure support system, one example being the mattress described in US Patent No. 5,396,671.

CLAIMS:-

1. A rotary valve for controlling air supply to an alternating pressure patient support system which comprises a body member (10) having a planar surface (21) and at least two apertures (25,26) for communication with cells or sets of cells in the patient support system, and a further aperture (22) for connection to a pressurised air source, an actuator member (12) which is rotatable in face to face contact with said planar surface, said actuator having a recessed portion (38) which forms an air supply chamber when in contact with said planar surface and is positioned to be constantly supplied with air from said further aperture, drive means (16,18) for rotating the actuator with respect to the first member and detector means (32) for detecting the position of the actuator relative to the body member and, in conjunction with control means, for controlling the timing and duration of air supply to the cells or sets of cells, wherein the drive means are capable of rotating the actuator in both directions.

2. A valve as claimed in claim 1 wherein the actuator also includes an aperture through which air can be exhausted in turn from one or other of said cells or sets of cells.

3. A valve as claimed in claim 1 or 2 in which the detector means comprises at least one optical sensor mounted in the vicinity of the actuator and arranged to detect the position of the actuator relative to the body member.

4. A valve as claimed in claim 3 in which the sensor interacts with apertures or slots in the actuator.

5. A patient support system having at least two inflatable cells or sets of cells wherein air supply to the cells is controlled by a rotary valve as claimed in any one of the preceding claims.

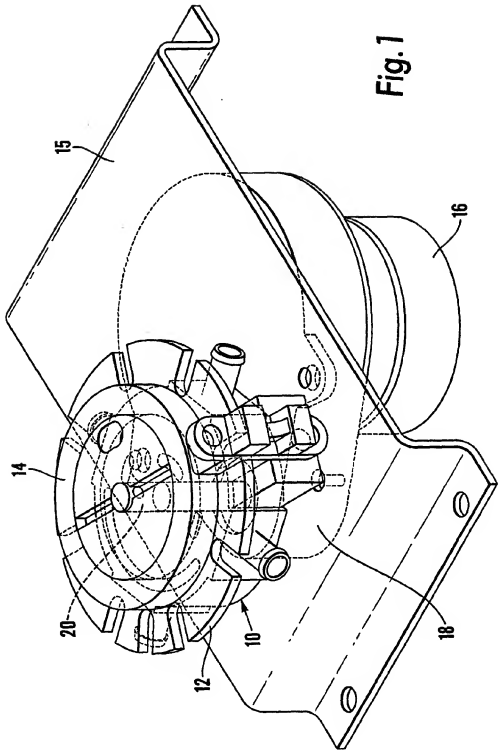


Fig. 1

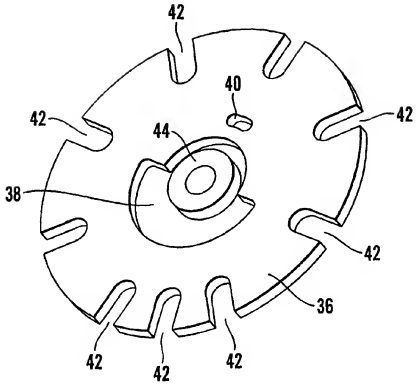


Fig.2

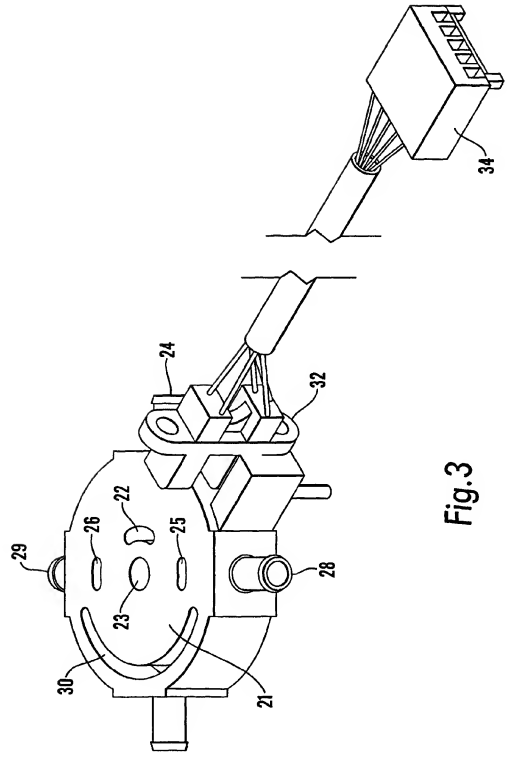
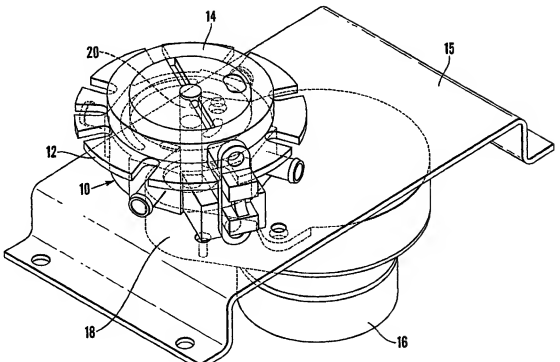


Fig.3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